Minutes of the Methane Hydrate Advisory Committee Meeting
June 7 – 8, 2005-07-20
Galveston, Texas

The meeting of the Methane Hydrate Advisory Committee (MHAC) was called to order at 7:41 a.m., Tuesday, June 7, 2005, by James Slutz, Deputy Assistant Secretary for Oil and Natural Gas and Designated Federal Officer (DFO), and Art Johnson, Committee Chair.

Mr. Slutz welcomed the MHAC participating members: Mr. Art Johnson, Dr. Miriam Kastner, Dr. Robert Woolsey, Mr. Emrys Jones, and Dr. Devinder Mahajan. Mr. Slutz noted that the Interagency Coordinating Committee (ICC) would participate in this joint meeting. Members of the ICC participating were: Dr. Bilal Haq, National Science Foundation, Dr. Bhakta Rath, Naval Research Lab, Dr. Pulak Ray, Minerals Management Service, Mr. Robert LaBelle, Minerals Management Service, Ms. Brenda Pierce, US Geological Survey.

Mr. Slutz, the DFO, noted that there was not a quorum of the MHAC present and therefore proposed that the meeting continue forward as a subcommittee meeting. DOE would investigate the requirements for any report or recommendation that comes out of this meeting to be validated by the entire committee, if required, before it can be submitted to the Secretary of Energy.

Each agency in the Interagency Coordinating Committee gave a 20 minute presentation describing their current and planned future activities relative to gas hydrates.

Department of Energy (DOE), Presenter – Ray Boswell, National Energy Technology Lab, reported that in the last five years researchers have greatly improved the capabilities of the lab studies to replicate natural conditions. DOE researchers have developed the first numerical simulators of hydrates and made them available to the public. DOE and industry have drilled in the last month the first dedicated hydrate well in the Gulf of Mexico, and have defined the first potentially economic prospects in Alaska. And DOE has also been able to support putting state-of-the-art equipment on Integrated Ocean Drilling Program cruises.

The major issue with the DOE hydrate program is related to the high technical risk inherent in the R&D, and the uncertain budgets. With existing budgets, DOE can only do one or two field projects at a time with each project taking three or four years. This is not a pace that's going to get us to the goals. Furthermore, it does not allow the program to conduct the number and range of studies that are required to adequately deal with the significant technical risks inherent in hydrates R&D.

To keep moving towards the program goals, DOE is expanding interagency collaboration. DOE has invited ex-officio reviewers from three of the cooperating agencies to help select better projects. DOE intends to make sure to keep the lab efforts relevant to the field work. In addition, DOE hopes to soon start an Alaska field test and continue working in Gulf of Mexico. DOE is going to work in Alaska first because we think it's the location where we can learn the most first. We're going to then try to take that sort of effort to the Gulf of Mexico; then worry about the world beyond that.

In response to a question about the future of the DOE program, Ms. Allison reported that there is very positive support for gas hydrates studies in Congress, but we won't know until we actually see the final appropriation. The reauthorization of the Methane Hydrate R&D Act of 2000 has been submitted by Senators Akaka, Murkowski, and Landrieu, and it has also been incorporated into the Energy Bill.

US Geological Survey (USGS) Presentation – Ms. Brenda Pierce
USGS has three centers working on gas hydrates: Woods Hole, Denver, and Menlo Park. And, each does something completely different. USGS is working in the Gulf of Mexico and Alaska and have been very active with the Mallik (Canadian arctic) project. USGS also works on the North Slope with both BLM and the BP/DOE Project. The USGS is actively characterizing the Alaska North Slope hydrates to do an assessment using the geological, geophysical, and engineering data. BLM has shared their 3-D seismic surveys to allow detailed characterization of the free gas and hydrate occurrences. So, USGS is going to go from an in-place assessment (1995), to technically recoverable, to economical assessments.

The report of research at the Mallik site is completed and available through the Geological Survey of Canada. This work was truly moved forward by being an international, interdisciplinary, interagency effort.

The USGS is starting a project with the Indian Government, where they will serve as science advisors to India's ambitious hydrate exploration program. India plans deep-water coring and well-drilling, but that was delayed. USGS will help them with site selection, how to go out and drill, resource characterization, et cetera. India is aiming towards commercial production of hydrates beyond 2008.

The analysis of data acquired during the Marion Dufresne Gulf of Mexico piston coring cruise (funded by DOE), is mostly finished, and reports should be out later this year or next year.

There were several questions about the status of the Japanese program. Ms. Pierce reported that the general understanding is that after their program a couple of years ago when they based their drilling program on BSR characteristics and found hydrate-bearing sands, they began mapping potential reserves based on BSRs. In 2004, Japan drilled 16 holes, 14 of them through BSRs and two outside BSRs. What they basically found was shale with a few very thin sands containing hydrate and some nodular hydrate filling fractures. This data put their reserve estimates in question and confirms the idea that stratigraphy matters; that if you don't have sand, you don't have a resource; and that while the BSR marks the phase boundary, it tells you virtually nothing about what's happening in the sands. There is little information on what Japan intends to do in the future, based on this unexpected drilling result.

Minerals Management Service (MMS) Presentation – Robert LaBelle
MMS has a three-pronged approach in responsibilities with regard to hydrates. First, MMS will do a realistic assessment of this resource, and its role in the national energy picture. MMS is getting ready to do its next five-year oil and gas resource assessment, which may include gas hydrates. Dr. Pulak Ray provided information on MMS development of a hydrate assessment

methodology that will be required to determine the value of OCS leases for gas hydrate production. The work is being conducted in partnership with USGS. The "petroleum system" approach will be used will all available data to define the hydrate stability zone, predict the occurrence of sandstone reservoirs within the stability zone and evaluate the likelihood of gas charge in a potential reservoir.

The second prong is be safety issues and flow assurance. Third, MMS is evaluating what hydrate production would mean to the environment. MMS is developing assessments of the chemosynthetic communities associated with hydrates. This data will aid MMS is fulfilling its NEPA requirements. One project of interest is MMS new study of chemosynthetic communities through National Geographic Partnership Program. The project will characterize known or recently discovered chemosynthetic communities in the Gulf of Mexico below a thousand meters, and offers a potential of discovery of new communities.

Naval Research Lab (NRL) – Dr. Bhakta Rath

NRL has had a long-standing interest in the acoustic properties of the seafloor and the effects of the sediments on navigation, which has led to study of the chemical and acoustic properties of subsea gas hydrate. NRL researchers have been actively studying gas hydrates in Cascadia Margin, Texas-Louisiana Shelf, Blake Ridge, Nankai Trough in Japan, offshore northern Chile and north of Calais, France. NRL has for four years sponsored and organized an annual International workshop to coordinate and discuss multinational gas hydrate expeditions.

Geochemistry studies include measuring geochemical parameters such as sulfates, sulfides, chlorine sulfate, and sulfide water, and determining hydrate histories from carbon isotope measurements. NRL believes it has the most unique capabilities to look at the carbon isotopes, the Carbon-14 and, and C-12, to identify and distinguish between the biogenic products, and the young carbon versus the old carbon.

Another unique capability of NRL is the deep towed seismic survey, the DTAGS, involving the Modern Surface Tow, MCS. The one and a-half ton system, which can move very close to the sediment, gives much higher resolution than other systems. It can operate at a much higher frequency, more like 100 to 1,000 Hertz, rather than 20 or 30 or 40 Hertz.

Dr. Rath stressed that NRL depends primarily on non-Navy funding and is therefore committed to cooperative studies. He also noted that ship time is very expensive, $200,000 to $250,000 for 10 days, with the regular risk of not being able to collect data because of weather or other conditions. However, the need for data and samples makes this work critical. Dr. Rath concluded by encouraging the government agencies to focus their studies, work closely with industry and form international collaborations.

National Science Foundation Program – Dr. Bilal Haq

NSF continues to fund a large amount of academic research in gas hydrates. Several divisions of NSF are involved - three or four programs. Ocean Sciences has several programs, including Ocean Drilling Program. Our Earth Sciences Division is also involved in that. And some special programs include carbon cycle, the industrial partnership programs, and even IT programs are funding bits and pieces of the hydrate research. And, of course, there were a wide range of

activities, Climate change being the most important one; but also fundamental chemistry of the hydrates, biochemistry and slope stability are supported. About 15 projects are active this fiscal year. The active projects cost NSF about $6.2 million, with an additional estimated $2.2 million in ship costs.

Among the interesting results, scientists have shown that hydrate ridge off the Oregon coast shows slope instabilities coincident with low sea-level events. It as also appears that gas delivery varies from site to site, and, but seems to be occurring in pulses rather than continuously at hydrate ridge. Other research shows evidence of global destabilization of methane hydrates as far back as 600 million years, based on the study of carbonate caps and C1-C3 analysis. This has implications for recurring hydrate destabilizations throughout Earth history.

Discussion of Interagency Cooperation Issues:
Mr. Slutz noted that at the last Interagency Coordinating meeting the question was raised of developing an interagency roadmap that would specifically define R&D gaps and any potential overlap. Ms. Pierce noted that each agency has its own mission and this helps preclude overlap. Perhaps more communication is needed, although the gas hydrates program seems to be the best coordinated government research program that any of these agencies are involved in. An industry representative concurred with the assessment that interagency cooperation is very good. The discussion focused on how lack of communication of the differing roles of various agencies could contribute to funding reductions.

The discussion moved to the need for greater industry involvement and funding. One industry representative noted that the lack of surety of DOE funding and continuity of funding makes industry hesitant to invest in cooperative studies. Industry also needs to see a clear financial return within a reasonable timeframe

A discussion about international information exchange that could help clarify what is happening in Russia, formerly a leader in gas hydrate R&D. Funding for both research and travel to technical meetings seem to be the problems for Russian scientists. Dr. Kastner suggested that government agencies dedicate some funds to fellowships for foreign students and scientists. A major stumbling block for agencies may be the requirement to hire U.S. citizens.

University of Mississippi Hydrate Research Consortium Report – Dr. Robert Woolsey
The consortium has funding from MMS, DOE and NOAA and is focused on building and installing a seafloor monitoring station, the preliminary elements of which are being installed at Mississippi Canyon block 118 in over 800 meters water depth. The site has been previously surveyed and was selected by a group of experts.

Chevron Joint Industry Project (JIP) Report – Emrys Jones
This information represents the very early, preliminary reports from the cruise to sample Lots 13 and 14 in Atwater Valley and Keathley Canyon area, Block 151, which ended May 21. These areas were selected after significant seismic and seafloor study with the objective of validating technologies to predict the location and quantity of subsurface hydrates that could prove a danger to conventional oil and gas operations.

The testing and drilling effort included 5 wells at two locations: three in the Atwater Valley area and two in Keathley Canyon. Three of these were logging wells. Two were coring wells. In addition, the JIP drilled two shallow wells over surficial mounds in Atwater Valley. The Deep Atwater Valley wells found trace hydrates, and enabled measurement of the geographic extent of salinity impacts related to focused flow feature. The shallow Atwater mound wells found some hydrates, but not the high concentrations expected. At Keathley Canyon, logging results showed a 90-meter section containing up to 30% hydrate saturation, likely related to fracture-enhanced permeability. These estimates differ from that derived from the core data, and this issue is currently being investigated. Overall, about 700 feet of core was collected from all the wells, but only about 4 feet of core were recovered under pressure because of problems with the pressure coring systems. Several cores contained hydrates and several had evidence of hydrates but no physical recovery. Cores were evaluated on the ship using X-ray and Infrared scans and gas and pore water chemistry sampling. Additional analysis is ongoing. High quality well logs were acquired and are being interpreted. A VSP was run at Keathley Canyon. Finally, it appears that the seismic-based pre-drill estimates (at Keathley Canyon) were successful in determining the overall location and relative abundances of hydrates. Similar data for Atwater Valley were not yet available.

The research done at Georgia Tech for the JIP was discussed. The research uses a pressure vessel that can sample the contained core and take resistivity, shear-wave and compression-wave measurements. The objective of this work is to enable the on-site determination of hydrate-sediment mechanical properties using samples still under in-situ pressure. The initial results indicate that these measurements are significantly different from those measured on cores which have been depressurized, indicating that future cruises will need to deploy this capability.

BP Alaska Project Report – Mr. Robert Hunter

The primary objective of this project is to characterize the resource potential of gas hydrates on the North Slope of Alaska, to enable industry and government to make more informed decisions regarding the resource potential The project has progressed to the point of not only reservoir modeling, but also economic and development modeling. Phase 1 occurred over the first two years of the program, during which time the study characterized the reservoir and fluids, identified prospects, and calculated in-place resources to verify their size and extent of compartmentalization, primarily within the Milne Point Unit area on this North Slope. The drilling and completion and production methodologies were also studied during this time. Phase 2 was redesigned to prepare for aligning possible future data acquisition with current industry projects, and to plan for specific potential field operations if the project progresses into Phase 3, a decision which the DOE and the resource owner will make based upon the Phase 2 results. Phase 2 is continuing the reservoir and fluid characterizations, ranking its prospect opportunities, evaluating the regional hydrate potential, and preparing detailed alternative scenarios for future field operations. Phase 3, future studies then would include drilling and potential production testing.. Successful Phase 3 research results, if they're aligned with industry business drivers, could lead to a future Pilot Development Program, the results of which could create significant value to industry, government, and to other gas hydrate research programs. Mr. Hunter continued to describe the data input and modeling results.

The meeting adjourned for the evening, and resumed at 8:09 a.m., Wednesday, June 98, 2005.

The meeting started with a short discussion of the process that will probably be required to submit a report to the Secretary, based on only a subset of the committee meeting. Then, Edith Allison explained the proposed changes in the advisory committee rules and procedures, specifically the new requirement, should the advisory committee be reauthorized (the current authorization expires September 30, 2005). In the future, members of the advisory committee will be special government employees. This will require: government hiring process for temporary employees, a waiver if anyone receives government funding, financial disclosure and conflict of interest certifications. This is essentially what the NSF requires for scientists that sit on their proposal review panels. The area of greatest interest is the requirement that individuals can not speak on a project funded by DOE before the committee.

The committee then moved to a discussion of its draft report to the Secretary. The committee developed the following points to include in the letter:

- There is a high level of cooperation between government agencies. Advisory committee recommends this continue
- Also, strong International cooperation – Program has international policy implications
- Need more focus on high priority areas
- Need to understand better the sediment-hydrate interaction-(currently is a major focus)
- Characterization is still required – see examples below
- Why can't industry do this?
    - Main industry interest is safety, although industry now simply avoids potential hydrate areas (will need to do joint industry projects)
    - Need specialized tools without other commercial value – now we know it is worth investing in these tools and know the tool parameters
    - This resource has a long lead time

- Achievements: shows this program has been worthwhile and should be continued – has been instrumental to following achievements. Program and excellent example of government-academic-industrial cooperation for basic knowledge – Meets President's goals for National energy policy.
    - DOE sponsored projects have showed that hydrates have potential to be commercially viable- recoverability and producability progress
    - This is no longer a 20-year potential resource
    - Can see the final goal (off ramp)- but need funding to drill test well
    - There is too much uncertainty for industry to do this on their own at this time – both reserve volumes and production technology (i.e., economic expectations) are too unpredictable for industry investment
- R&D continues to confirm with growing certainty that hydrates represent a large potential energy resource- are on the right track
    - Technological advancements has increased understanding of the hydrate system
    - New technologies have been developed
    - We have made significant progress toward methane production from hydrates, primarily permafrost

    - Quantitative modeling of specific prospects based on detailed data – industry standard for drilling spending decisions. This is much more precise than past general estimates
    - Mallik experiment shows methane will flow from a well/reservoir

- Marine
    - Marine will lag arctic due to cost and rig availability
    - Marine hydrates progress has been to relate reservoir parameters to remote sensing
    - But future investments are needed- GOM test would be beyond current budget
- Support for International efforts will benefit the U.S. program
- Field work in environmental or slope stability would require additional funding – example pressure coring capability
- New tool development is required to answer uncertainty, for example pressure/temperature controlled coring and pressure/temperature controlled sampling and measurement (volume, sediment interaction) – enhanced funding required- no incentive for industry to fund this until producibility shown
- Need basic understanding of volume and location by remote sensing
- Future view- five years out we expect: dependent on funding level
    - Arctic hydrate production would be validated although some production technologies would remain to be refined
    - In five years will have demonstrated that hydrates will be ultimately capable of contributing significantly / 10% to U.S. gas production – will require major arctic and/or GOM test results
    - Transportation of gas from hydrate will be dependent on infrastructure, for example Alaska pipeline
- Seafloor stability
    - Significant technology advances, for example use of ASV, high resolution seismic systems that can record polarity
    - Need models to predict real settings from lab data
    - Global climate change prediction needs basic data of sediment-hydrate relationships
    - Still do not know if hydrates cement grains or fill pores – defines sediment strength – a reason for doing basic characterization
    - Need to identify and monitor areas with potential for sliding – what is there and what factors can impact it
    - Need interdisciplinary studies to leverage knowledge and better apply data – hydrate-sediment characterization applies to environmental, slope stability and production
- Environmental
    - A major contribution of other government agencies – but more coordination with NSF
    - Before any production can proceed will need a realistic technologically appropriate scenario for NEPA
    - Need to (and can benefit from) involve international community

- Need to utilize seafloor observation and monitoring systems for baseline data relating to gas hydrates and the environment – will need to involve other agencies and oil companies (with safety and operation expertise)
- Safety information on gas hydrates is widely shared with other companies and regulators. Industry is very cooperative in sharing safety info – may not currently get to all hydrate researchers. DOE needs to be more aware.
- Note there is a public perception that hydrates will be harvested from seafloor mounds, which is untrue. Current R&D shows production will be from the subsurface utilizing adapted, modified conventional technology. Will not use surface mining.

- Overall Recommendations:
  - More money
  - Increase hydrate education - Postdoctoral program should be instituted
  - Continue interagency coordination

Arthur Johnson, Methane Hydrate Advisory Committee Chairman

James Slutz, Designated Federal Official